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US 5762291 A

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(54) Abstract Title
Artillery projectiles

(57) Artillery projectiles typically have a spread pattern generally worse in a longitudinal direction. To overcome this and improve accuracy the nose (2) of a shell (1) includes a conventional fuse unit (3) selectable according to requirements and screw connected with the nose (2) of the shell (1). The fuse has peripheral segments (5) which pivot outwards about hinges (6) to the position shown following deployment from a position embracing the fuse casing. Deployment is triggered during the trajectory of the shell by a GPS receiver system (11) with antenna (10) which has been preprogrammed with target position data. The segments produce drag to brake the projectile at a defined point relative to the target. The segments may be joined by flexible membranes to increase the drag.

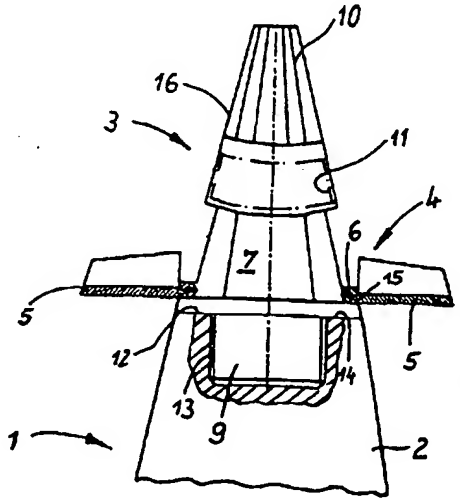

Fig.1

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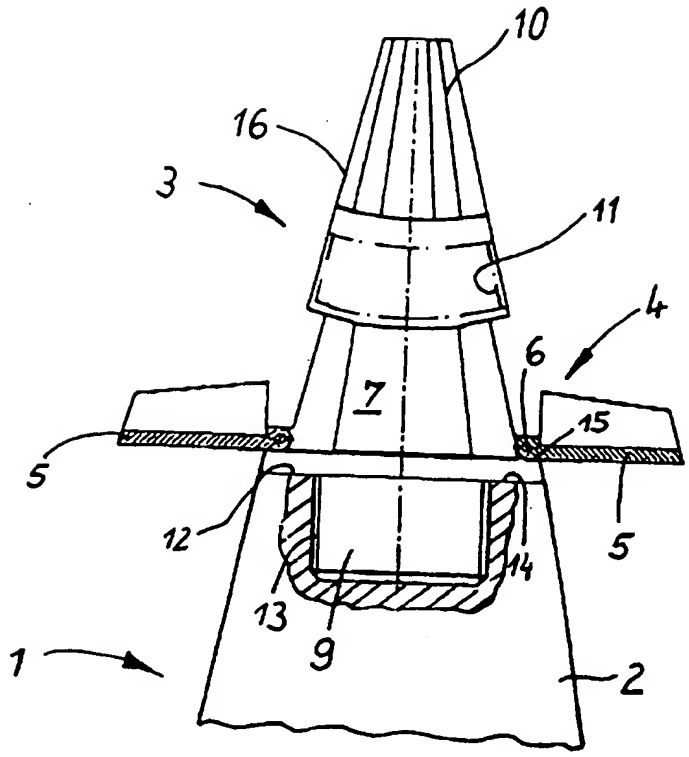

Fig.1

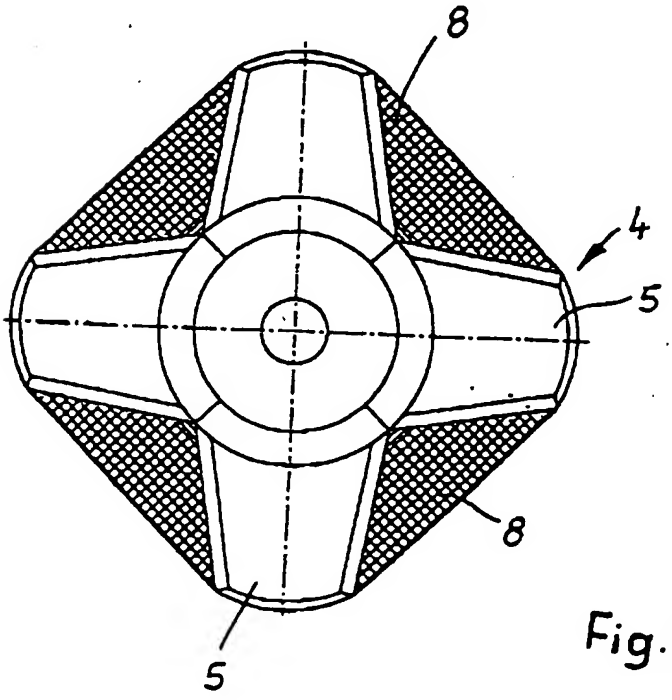

Fig.2

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TITLE

GPS Controlled Projectile

This invention relates to a projectile controlled by a satellite navigation system, for example by GPS (Global Positioning System).

It is known that conventional projectiles fired from guns have a typical target spread pattern in which the lateral dispersion is limited but the longitudinal dispersion is very much higher. If this could be corrected this would not only considerably reduce the ammunition required but also result in a noticeably improved target hit rate.

A GPS controlled spin-stabilized artillery projectile for using automatic guiding and braking is known from DE P 19740888.5 . In this case the guiding and braking means comprises fins which can pivot out from the body of the projectile. This projectile calls for a high outlay on development and production. Owing to the unique design, this projectile is impractical for use with existing ammunition.

An object of this invention is to provide conventional artillery projectiles with a means to produce better accuracy and a less spread pattern by reducing longitudinal dispersion.

According to this invention there is provided a projectile, wherein a detonator fuse unit includes a GPS-sensor and a braking means actuated by the sensor to cause the projectile to be braked in accordance with the position of the projectile.

This invention is based on the replacement of a conventional detonator

fuse unit by a detonator fuse unit having a GPS-sensor controlled trajectory modifying unit. This enables any deviation of the projectile flight path to be determined by comparing the programmed required flight path with the position measured at any instant using the GPS-sensor system. Using known aerodynamic parameters and at a defined instant a control unit can be actuated which effects target orientated drag braking of the projectile. This results in a reduction of the dispersion in the longitudinal direction without the need for any modification of the actual projectile or ammunition. The standardized interfaces in relation to the ammunition are retained unaltered, so that the system can be applied to ammunition already in service.

The fuse unit is easy to remove and replace and is more economical than complete development of new ammunition or projectiles. The reduction of the longitudinal dispersion also results in a reduction in the ammunition required.

The control unit according to this invention through the increase in drag causes the projectile to be braked so that the flight path and range is shortened. After the degree of error has been determined the most favourable moment for the activation of the control unit is calculated and implemented.

The control unit advantageously comprises at least two, preferably four casing segments enclosing the projectile fuse, these being pivotable outwards and back to produce drag.

To increase the drag the gaps between adjacent segments can be filled with a membrane of high-strength fabric or plastic, at least three casing segments are proposed in order to ensure faultless operation.

For the performance of the position sensing function the detonator is

provided with an antenna at the front and an internal electronic GPS receiver system which serves to activate the braking unit at the rear preceding the detonator fuse.

This invention will be further described and illustrated with reference to an embodiment shown by way of example in the drawings.

In the drawings:-

Figure 1 shows in part longitudinal section the nose of an artillery projectile with a trajectory correction unit deployed and mounted on the detonator unit, and

Figure 2 shows a plan view of the detonator shown in Figure 1.

Referring to the drawings, Figure 1 illustrates a projectile 2 forming part of an ammunition system 1 which is known and therefore not shown in detail. At the front end 12 of the projectile 2 an ammunition detonator fuse 3 can be attached through a screw connection and in a known manner, to bear against a projectile end face 14.

The projectile detonator unit 3 contains a GPS-sensor controlled correction unit 4 serving to brake the projectile 2 in accordance with the position of the target. The correction unit 4 comprises at least two casing segments 5 which are pivotable forwards from the guiding or braking function position shown to a position around the periphery of the detonator 3.

The casing segments 5 are connected by hinges 6 to the body 7 of the detonator 3, the hinge connection being made of a high-strength material and being pivotable through about 90° from a fixed stop 15 and forwards in relation to the direction of flight to a stowed position, in which position the segments can be secured. The activation of the segments 5 for deployment by the pivoting

movement can be effected, for example, by pyrotechnical means in a manner not illustrated.

The body 7 of the detonator 3 is so constructed that the segments 5, before being pivoted out, conform with the preferably conical external contour 16 of the detonator 3. Drag braking membranes 8, when the casing segments 5 are stowed, are positioned inside the detonator housing so that they do not produce drag.

In the extended state the peripheral spaces between adjacent segments 5, of which four are preferably provided forming quarter shells, are filled with a membrane 8 connecting the adjacent segments 5. In order to ensure that the braking sheet 8 will stand up to the high pressure forces occurring during the braking process after deployment, the material comprises a high-strength fabric or plastic. The braking effect is considerably improved by the large area of the braking membranes particularly where four segments or more, for example six, are provided.

The rear part of the detonator 3 is fitted, in the zone of the screw threading 13, with a known detonating and safety fuse device 9. At the front the nose of the detonator is fitted with a GPS antenna 10, behind which an electronic system 11 is provided forming a GPS receiver. The casing segments 5 of the correction unit 4 are thus positioned in the zone of the maximum diameter of the projectile detonator 3 between the electronic system 11 and the fuse 9, so that the volume available makes the position stable and the unit, particularly the segments 5, can be given sufficient area.

The detonator functions as follows:

The projectile detonator 3 is screwed onto a conventional projectile 2

prior to the loading operation and by means of a programming and fuse setting unit mounted on the weapon (not shown). The fuse is provided with necessary data, such as required flight path, GPS-satellite position, time, detonation data, target location.

After the commencement of the ballistic flight phase the GPS unit 10,11 is activated. After the initiation of the GPS receiver the instantaneous position of the projectile is determined and compared in the electronic processing unit with the required flight path. After the error parameters have been determined the most favourable moment for activating the correction unit 4 is calculated and this operation then performed. The correction unit 4, by increasing the drag coefficient, brakes the projectile and this shortens the range. For the purpose of attacking the target the conventional fuses, such as impact, ejection or proximity are activated. The detonating and safety fuse unit 9 illustrated is in accordance with a conventional detonator.

CLAIMS

1. A projectile, wherein a detonator fuse unit includes a GPS-sensor and a braking means actuated by the sensor to cause the projectile to be braked in accordance with the position of the projectile.

2. A projectile according to Claim 1, wherein the braking means comprises segments forming a casing around the projectile fuse unit, the segments being pivotable outwards to effect the braking action.

3. A projectile according to Claim 2, wherein at least two pivotable segments are positioned around the periphery of the fuse unit.

4. A projectile according to Claim 2 or 3, wherein the segments are each connected through a hinge to the fuse unit.

5. A projectile according to any one of Claims 2 to 4, wherein the gap between adjacent segments following deployment includes a membrane connected with the segments.

6. A projectile according to Claim 5, wherein the membrane comprises a high-strength fabric or plastic material.

7. A projectile according to claim 5 or 6, wherein the fuse has three or more segments.

8. A projectile according to any one of Claims 5 to 7, wherein the membranes are housed within the casing formed by the segments prior to deployment.

9. A projectile according to any one of Claims 1 to 8, wherein a detonation and safety device is situated in a rear part of the detonator and fuse unit, a GPS antenna being located in a front part of said unit and an electronic system forming a GPS receiver being located in the interior of said unit.

10. A projectile according to Claim 9, wherein the segments are located between the detonating and safety device and the electronic system.

11. A projectile constructed and arranged to function as described herein and exemplified with reference to the drawings.

12. A fuse unit for a projectile according to any preceding claim.

The Patent Office

INVESTOR IN PEOPLE

Application No:	GB 9912065.1	**Examiner:**	R C Squire
Claims searched:	all	**Date of search:**	10 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F3A; F3C

Int Cl (Ed.6): F42B; F41G

Other: Online:WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 98/01719A	SECRETARY OF STATE (see particularly page 4 paragraph 4)	1
X, P	US 5816531	HOLLIS (see particularly col.1 line 43)	1
X, P	US 5775636	VIG (see particularly col.1 line 57 to col.2 line 3)	1
X, P	US 5762291	HOLLIS (see particularly col.1 line 40)	1,2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.